Research Brief for
DOE/IHEA Process Heating Materials Forum

Research Title: Materials Test Methods, Alloy and Ceramic Selection and Development for Elevated Temperature and Aggressive Environments

Industry Need: As users of high temperature equipment for calcination, incineration and vitrification, and as a research institution, the Savannah River Site and the Savannah River Technology Center have had extensive experience in the engineering, construction, and operation of high temperature equipment, and the fabrication and development of alloys for use in high salt, high sulfur and molten salt/glass environments.

Existing Research: Research topics include incinerator belt materials, tubular resistance heaters, electrodes, glass contact metals and ceramics, in oxidizing, mixed salt, sulfidation, chloride, and mixed acid environments. Alloy development furnaces and full analytical capabilities are available in house including high temperature creep, creep rupture, tensile test, stress intensity, and fatigue testing, ICPES, ICPMS, SEM, STEM, XRD, XRF, AFM, EDAX, ESCA, TGA/DTA/MS/DSC and full wet chemical methods. Development and use of small and pilot scale furnace units for exposure to process environments for material improvement has been a specialty.

In addition to general engineering activities, SRTC has research groups dedicated to Weld Engineering, Materials Compatibility & Joining Technologies, Materials Applications and Process Technology, Materials Consultation, Materials Performance and Corrosion Technology, And Non Destructive Examination and Materials Reliability.

Current research topics involve specialty ceramic formulation and fabrication, nickel and cobalt alloy formulation, and plasma coating of high temperature alloy and ceramic parts.

The Savannah River Technology Center is internationally recognized for its contributions to hydrogen embrittlement and fracture mechanics and environmental effects on metal cracking.

Proposed Activity:

1) **Alloy and Coating Development** for high temperature exposure to salt, glass and sulfidizing environments are continuing. This work could be extended to include special environments or materials of interest to industry. This could include simulation of operating environments, determination of failure mechanisms, and determination of probable solutions and demonstration of solutions. Cooperative arrangements are encouraged, where work and costs are split between the participants.

2) **Failure Analysis** with applied or fundamental study of failure mechanism. This can include mechanistic, statistical or risk based analyses. This could be developed as the result of material consultation, production experience or field inspection.

3) **Test Method Development**: This can include exposure of stressed, cyclically loaded, tensile samples in environmental chambers at elevated temperatures to 600^0C, Gleeble thermomechanical testing to the melting point, or development of specialized equipment.

4) **Sensors and Environmental Monitor Development**: SRTC recently won an IR100 award for development of simplified viscosity measurements in operating furnaces, and is participating in methods for analyzing sodium species in operating furnaces. Current programs include applied optical, laser, microwave and chemical sensors for environmental monitoring and thermal processing. Experimental mechanics methods used include residual stress analyses, laser holographic and speckle interferometry, mass spectroscopy and laser metrology.

Contacts/Lead Scientists:

Dennis Bickford, Advisory Engineer, dennis.bickford@srs.gov, 803-725-5045,
FAX 803-725-4604